Revision: March 4, 2008

"HealthRun" Policy Simulation Game
Overall Design, Preliminary Insights, and Future Directions

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Learning to Succeed in a Simplified System

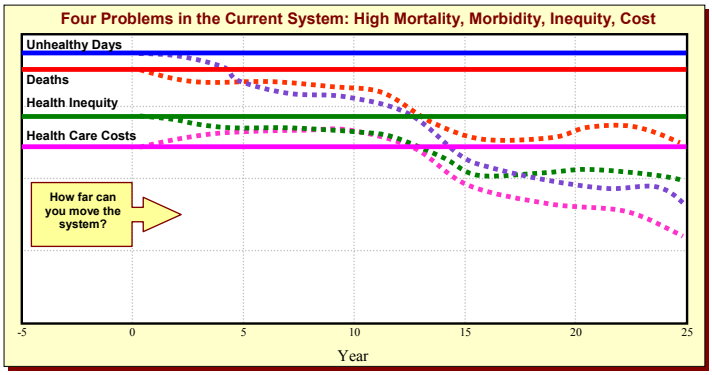
CDC developed the *Health Run* game for those wanting to experience the possibility of transforming our troubled health system. Players are equipped with the power to navigate the U.S. health system toward greater levels of health, equity, and cost-effectiveness, if only they can discover how (Fig 1).

Solving a Systemic Problem

The players' goals are difficult to achieve, in part, because the game includes resource constraints, time delays, and side effects of intervention similar to those of the actual health system. These complicating features must be understood in order to succeed.

The game allows tests of single interventions, as well as a high degree of creativity in mixing them for better effects. There is also a transparent causal structure that allows players to identify the precise reasons for patterns observed in the game. Players learn by simulated experience and by tracing through the reasons for their successes or failures.

Figure 1 The Challenge: How Far Can You Move the System?



A Foundation for Wayfinding Dialogues

Those who aspire to lead change on a national scale, or in their own sphere of influence, may benefit by first testing and refining their ideas in this realistic, but simplified version of the U.S. health system. They may play out popular proposals, explore new ideas, rule out ineffective strategies, and gather support for more promising scenarios. The game teaches essential lessons about how the health system works and establishes a productive frame for finding a viable way forward. CDC plans to continually refine the game in conjunction with its use it as the basis for a series of *Wayfinding Dialogues* in which stakeholders across the country consider what they can do to help steer a course toward a healthier, more equitable, and more prosperous future.

Prototype Design

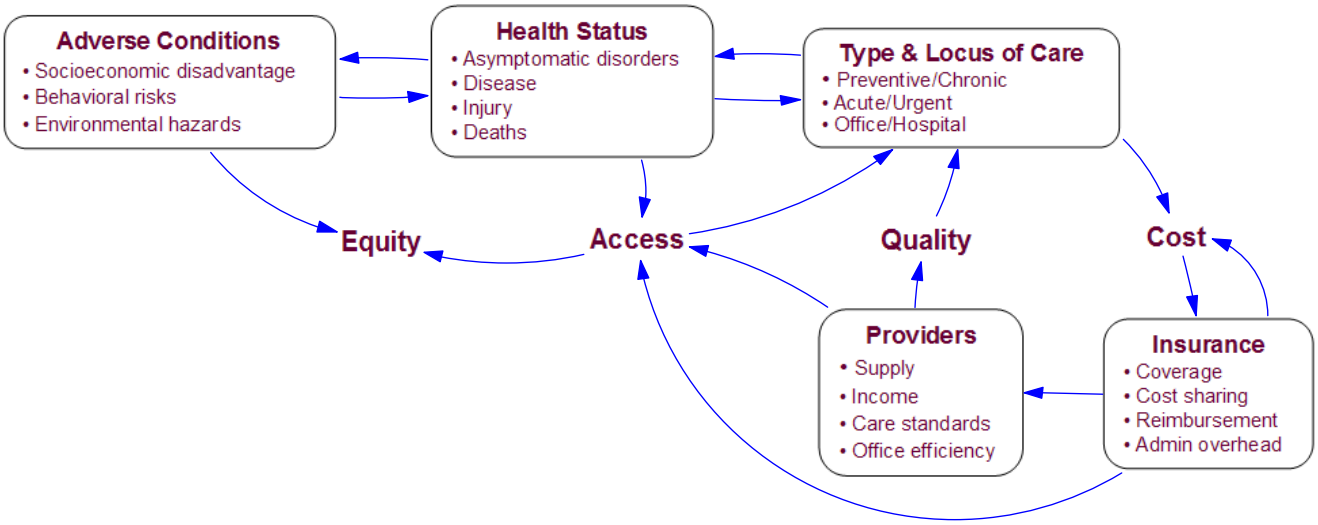
The game integrates data and findings from earlier studies on factors affecting health system performance.[1] Figures 2 and 3 show the main features of the health system that are included in the game's design. Two facts are immediately obvious: (1) all parts of this system, often considered separately in popular discourse and in analytic studies, are causally connected; and (2) there are more processes at work—as well as more intervention options available—than one might infer from many discussions of health care reform.

[1] Selected references are below.

An Integrated View of Health System Dynamics

All patterns observed in the game arise from interactions among different parts of the health system. Figure 2 shows which elements make up the game's health system and how they are connected. Below that is a more detailed description of how the game is designed, including a map of its major causal pathways (Figure 3). That figure shows where each intervention option fits within the larger health system.

Figure 2: Major Elements Represented in the *Health Run* game (version 4d)[2]



Causal Pathways

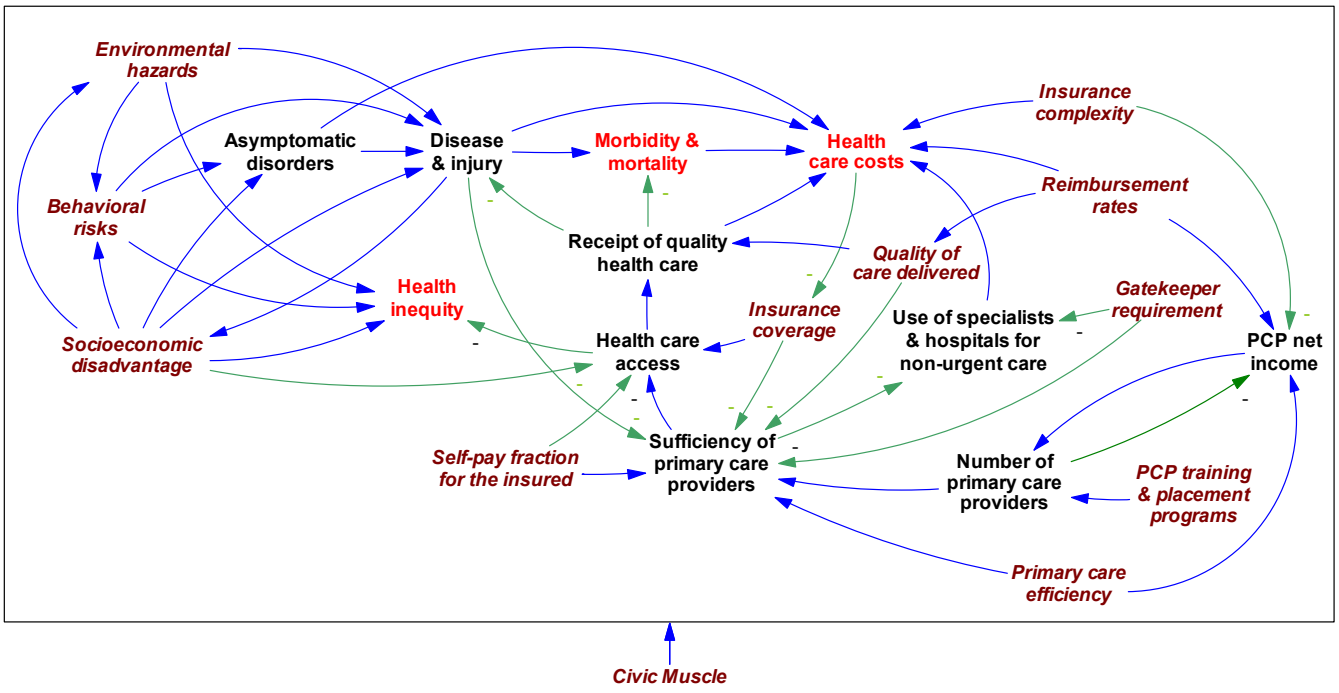
The game's simulator tracks the entire U.S. population and its movement among states of health, risk behavior, environmental exposures, and socioeconomic advantage or disadvantage. Disadvantage erodes people's health by making life more stressful; it also makes it harder for people to choose healthier behaviors and exposes them to more hazardous environments, leaving them more vulnerable to an array of afflictions that increase aggregate disease and injury prevalence. The disadvantaged also have worse access to health care than do the advantaged, due to less insurance coverage and less sufficiency of primary care providers to meet patient demand. Greater disease prevalence combined with worse access to care means that the disadvantaged experience greater morbidity and mortality per capita than the advantaged do. Another factor affecting health outcomes is the quality of care delivered, reflecting the extent to which providers follow guidelines for best practice with regard to screening, monitoring, and treatment. Quality of care may be improved by promoting best practice guidelines, but the incentive for such adoption is hindered if insurance reimbursement rates are not adequate. Figure 3 shows these relationships and stands as a broad summary of the game's causal structure, which actually contains several hundred interacting elements.

Scoring Criteria

Players attempt to achieve the best results across four criteria simultaneously (shown in red in Fig 3). They must (1) save lives; (2) improve well-being; (3) achieve health equity; and (4) lower health care costs per capita, all the while being conscious of total intervention spending or the number of simultaneous interventions. The game tracks these scorecard variables and many others over 30 years: beginning with a 5-year comparison period, followed by 25 years during which players may intervene.

[2] Many variables in the game are tracked separately by socioeconomic status, including those related to behavioral risks, environmental hazards, health status, type and locus of care received, the number primary care providers, access to health care, insurance coverage, and cost sharing.

Figure 3 Major Causal Relationships in the *Health Run* game (version 4d)[3]



Intervention Options

Players may employ several types of intervention, alone or in combination, to achieve their goals (shown in italics in Figure 3). These include (1) expanding insurance coverage; (2) improving quality of care; (3) reducing insurance complexity (e.g. through standardization of benefits or a single payer approach); (4) expanding the supply of primary care providers, particularly for disadvantaged populations, through training and placement programs and associated incentives; (5) improving primary care efficiency (allowing providers to operate at lower cost and better use their time); (6) changing reimbursement rates to physicians or hospitals; (7) requiring gatekeeper approval for specialist services; (8) changing the self pay fraction for those who have insurance (including self-paid premiums, co-pays, and deductibles); (9) enabling healthier behaviors (e.g., reducing tobacco use); (10) building safer environments (e.g., reducing air pollution); (11) creating pathways to advantage (e.g., through education, job training, living wage policies); and (12) strengthening civic muscle to enable more effective implementation of the other interventions. Many of these general interventions can be further tailored by focusing on particular areas of the system (such as office-based versus hospital services, or the disadvantaged versus advantaged sub-group).

Starting Conditions

A number of factors were excluded from the game on the premise that our health system would remain troubled even if certain ongoing trends were somehow frozen or eliminated. These include the adoption of new technologies, the "tug of war" over billing between insurers and providers, population growth and aging, the rise of defensive medicine, globalization of the medical marketplace, the medicalization of common ailments through direct-to-consumer advertising, increasing regulations on tobacco use, and trends in employment, transportation, recreational options, and food options. We have previously shown how some of these factors can create instability in the health system and cause costs to grow (see Homer, Hirsch, Milstein 2007). But, for the game, we defined a system starting in a dynamic equilibrium, with all outcome variables sitting close to where they were in real life around the year 2003—and unchanging. Players must identify the most powerful drivers of system behavior and use that knowledge to move from an initially undesirable state toward one that is healthier, more equitable, and more cost-effective.

[3] The game's main scoring criteria are shown in red and bolded. Italics indicate possible areas for policy intervention. Blue arrows indicate same-direction effects (e.g., more environmental hazards lead to more disease and injury), while green arrows indicate opposite-direction effects (e.g., greater sufficiency of primary care providers leads to less use of specialists and hospitals for non-urgent care). Operational definitions for each element are below.

This setup—where many features are intentionally held constant—allows us to rest the game on processes that are less transitory and lets players better understand the results of their decisions.

Empirical Foundations

The game integrates data and findings from earlier studies on factors affecting health system performance (see below). Because of its broad sweep, most variables are defined at a high level of aggregation. For example, the game does not consider individual types of disease or injury, but rather combines them all into a single measure of prevalence based on national surveys like the National Health Interview Survey and the National Health and Nutrition Examination Survey. Such aggregate metrics have been shown to be reliable predictors of health service utilization and health outcomes. In general, quantification of elements in the game is based on a variety of publicly available data from the Census, Vital Statistics, national health surveys, the National Health Expenditures database, and studies from the professional literature on health care utilization and programmatic impact. We expect to refine some concepts and estimates as we gather more information from research and subject matter experts, but aggregated representations will always be necessary to make the analysis tractable and consonant with available data.

Preliminary Findings

The game remains a work-in-progress and is being used to support dialogues with a widening circle of stakeholders. We present the following tentative findings as a preview of what participants are learning from their experiences playing the game. Future refinements may modify these findings and will likely sharpen them. These illustrations generally involve simulating just one intervention at a time. Combinations or sequences are possible, offering many possibilities for players to explore. In fact, some of the individual scenarios described below (e.g., universal coverage, quality of care) show both desirable and undesirable effects, suggesting the need for a multi-pronged strategy.

Cutting Reimbursement

Reducing reimbursements to office-based providers offers the promise of lowering health care costs. But it also has the tendency to diminish quality of care. The reduction in quality quickly leads to greater morbidity and mortality, particularly among those with chronic diseases. The game suggests that the increase in morbidity minimizes the net cost reduction from the outset, making it much smaller than one might anticipate. Also, the loss of income to providers causes their numbers to dwindle over time, leading to further worsening of morbidity and mortality. As a result, any initial reduction in costs is ultimately negated.

Achieving Universal Coverage

In the game, we can extend insurance to all—as attempted in Massachusetts and as proposed by numerous leaders—without assuming a single-payer approach or any further regulations on insurance companies or the products they offer. When we simulate universal coverage in this way, we see a quick (though relatively modest) reduction in morbidity and mortality, but we also see some increase in health care costs. Indeed, health economists have shown that disease management may be cost-effective but is rarely cost saving. In other words, universal coverage draws more people into a health care system that does relatively little to prevent disease in the first place, and so it does not reduce costs. More surprisingly, expanded coverage ultimately does not reduce the inequity between the advantaged and the disadvantaged. Although it is true that the disadvantaged are more often uninsured, the game also takes into account that, even for those with Medicaid or with access to public health clinics, the disadvantaged more often face a shortage of local primary care providers. When coverage is extended to all, the additional demand is fairly easily absorbed by providers to the advantaged, but not so for the disadvantaged. The disadvantaged may all be insured now, but they encounter even greater difficulty than before in getting seen regularly for their chronic conditions.

Improving Quality of Care

The game can simulate the effects of greater adherence to guidelines for effective chronic and preventive care by office-based primary care physicians and specialists. That improvement in quality results in a quick reduction in morbidity and mortality. In fact, the reduction in morbidity is greater than in the universal coverage scenario, because the quality improvement applies to a much larger segment of the population. Despite the reduction in morbidity, improved quality also leads to a significant increase in health care costs, due to increased physician visits and use of medications (again, disease management is not cost saving). Also, quality improvement worsens health

inequity. Quality improvement requires that providers give more routine care per patient, and this leads to some shortage of primary care providers for both the advantaged and the disadvantaged. In response, many of the advantaged are able to shift to specialists and maintain the same improved quality of care, whereas the disadvantaged cannot afford to do so. As a result, a greater proportion of the advantaged than then disadvantaged end up benefiting from the improvement in quality.

Strategies for Improving Health Equity

If players want to improve health equity, the game points to two strategies that could work. First, they could alleviate the shortage of health care providers who serve the disadvantaged, by offering more medical school scholarships and other incentives for students who commit to work with the disadvantaged after they graduate. A second approach is to reduce disease disparities that result from the greater vulnerability to affliction experienced by the disadvantaged. This approach entails either (a) creating safer environments and enabling healthier behaviors, both of which are disproportionately lacking among the disadvantaged, or (b) helping more people move out of their disadvantaged position, for example, through a mix of training/educational reforms and family income supports.

Upstream Health Protection: Reducing Environmental Hazards and Behavioral Risks

In line with the second approach described above, we have simulated a general health protection scenario in which strong population-wide efforts, not dependent on clinical resources, are made to reduce environmental and behavioral risks for both the advantaged and the disadvantaged. This "upstream" strategy takes some time to generate significant benefits, but ultimately the protection approach can reduce morbidity and mortality even more effectively than the quality-of-care strategy described above. Also, unlike the quality-of-care approach, the protection strategy ends up significantly reducing rather than increasing health care costs, and improves health equity, benefits that do not erode over time but actually keep getting better for the duration of the simulation.

Games Help Us Understand How the System Behaves and Why

Simulating interventions and seeing their effects is only part of the game. Deeper insights come from learning why and how our complicated health system behaves the way it does. For instance, why is the simulated upstream health protection approach so effective, and particularly so for the disadvantaged? The answer can be found in the causal connections and feedback loops pictured in Figure 3. The disadvantaged inherently benefit somewhat more than the advantaged from reductions in environmental and behavioral risks, thereby helping to reduce health inequities. But that is only the start. The reduction in disease prevalence then helps further in two ways, especially for the disadvantaged. First, a reduction in disease and injury prevalence eases the demand on scarce primary care capacity allowing more patients to be seen for preventive and chronic care. Thus, a virtuous cycle of prevention is created, and as a result, disease prevalence continues to decline further for a decade or more beyond the initial period of environmental and behavioral risk reduction. Second, a reduction in disease prevalence lowers health care costs, making insurance coverage more affordable, and leading employers to offer more coverage, thereby slowing and reversing the downward trend of recent decades. This increase in insurance coverage further improves health care access and leads to a greater improvement in health equity.

Next Steps: Refinement, Engagement, and Wayfinding

We will continue to meet with health system scholars to review the game's design so that we may improve its credibility and usefulness. We are also creating an on-line user interface and a group-based instructional design, so that we may extend the opportunity for stakeholders to interact with and learn from the game and from each other.

One of the biggest impediments to past reform initiatives has been that proponents of competing strategies have used different conceptual frameworks, each slanted to support their particular approach. CDC's *Health Run* game offers a comprehensive and neutral framework in which advocates of different transformation strategies can come together, test their proposals, identify potential shortcomings, and work together to craft a package of interventions that cuts through the current clutter and inertia to reveal a practical way forward.

Additional Background

How are Major Elements in the Game Defined?

Below are operational definitions (in alphabetic order) for major elements in the game's causal structure (Fig 3).

Asymptomatic disorders: Precursors to chronic disease for some people; these include hypertension, high cholesterol, pre-diabetes, and early stage chronic conditions (e.g. HIV, cancer) which, in many cases, may be controlled with medications and/or lifestyle change.

Behavioral risks: Unhealthy behaviors that increase the risk of disease or injury, or of developing organic disorders. Some of these behaviors include smoking, poor diet, physical inactivity, drug and alcohol abuse, unprotected sex, and violence. The fraction of people with risky behavior may increase over time due to behavioral lapse or decrease due to behavioral reform. *Players may enable healthier behaviors among the advantaged and/or the disadvantaged population.*

Civic muscle: The ability to enact chosen interventions at their desired strength. Many intervention options require up-front investment. The extent to which the full required investment can be made depends on having sufficient capacity to take action. Civic muscle reflects people's power to focus time, attention, and resources on a particular course of change. Any one of the available interventions may provoke resistance from vested interests who seek to maintain the status quo. Effective leadership and broad-based organizing among institutions and citizens are necessary to overcome that resistance and ensure that the chosen interventions get the necessary funding and support to be enacted. *Players may strengthen civic muscle with a view toward acting more effectively elsewhere in the system.*

Disease and injury: Conditions are that are disabling or symptomatic (or would be if not effectively managed) or are imminently life-threatening (e.g. a later-stage cancer).

Environmental hazards: Hazards and pollutants in the physical environment that increase the risk of disease or injury. The fraction of people in unsafe surroundings may increase over time due to environmental degradation or decrease due to environmental remediation. *Players may build safer environments for the advantaged and/or the disadvantaged population.*

Gatekeeper requirement: A policy to extend the requirement, already imposed under some health plans, that patients first go to a primary care provider and get a referral before seeing a specialist. *Players may enact or later remove this requirement.*

Health care access: The ability to obtain quality care from physicians and hospitals. Access requires insurance coverage and, in the case of office care, a sufficient number of primary care providers. Both of these requirements are greater obstacles for the disadvantaged, who initially are less likely to be insured and more likely to encounter a shortage of providers.

Health care costs: Total health care spending for all personal health services and supplies, plus the administrative costs of health insurance (as described in the National Health Expenditures database). Together, these categories cover 90% of all costs in the NHE, excluding only public health activity, research, and investment in structures and fixed equipment. Leading categories of personal health costs are hospital visits, physician office visits, use of medical products, and spending on nursing homes and home health care. Morbidity increases costs through demand for *urgent and acute care*. But effective *routine and preventive care* is also a major cost driver, and would become more so if the extent of such care were to increase.

Health equity: Degree of equality between the disadvantaged and the advantaged with regard to health risks, health care access, and health outcomes (morbidity, mortality). Greater equity is attainable by (a) reducing the total number of people who are disadvantaged; and/or (b) reducing the excess vulnerability or barriers to health care that are

associated with being disadvantaged. An index of inequity calculates the fraction of total unhealthy days attributable to the gap between the disadvantaged and the advantaged.

Insurance complexity: The number of different health plans and their internal cost of administration, as well as the burden on the billing function of physician offices. Standardized health insurance plans (analogous to what some states have done with auto insurance) could reduce the burden for physicians, but would leave intact a private system with high costs of marketing and negotiation. A single-payer approach could simplify the burden for physicians and eliminate these extra costs of private insurance administration. *Players may standardize insurance plans, or implement a single-payer approach.*

Insurance coverage: The fraction of people with private or government-provided health insurance. *Players may expand insurance coverage for the advantaged and/or the disadvantaged population.*

Morbidity and mortality: The number of unhealthy days per month (morbidity) associated with disease and injury, along with the number of urgent events requiring emergency hospital care. Some fraction of those urgent events result in death (mortality).

Number of primary care providers (PCPs): The total number of physicians in general practice, family practice, internal medicine, geriatrics, pediatrics, and obstetrics/gynecology, as well as nurse practitioners. We distinguish PCPs who primarily serve either advantaged or disadvantaged clients; many of the latter work in public health clinics rather than private practices or managed care organizations.

PCP net income: The average revenue of PCPs minus their average operating and billing costs. Net incomes are typically higher for PCPs who primarily serve the advantaged rather than the disadvantaged population. Interventions can affect net income in 3 ways: (1) revenue goes up or down based on reimbursement rates; (2) operating costs go down with greater office efficiency; and (3) billing expenses go down with simpler insurance schemes (standardized plans or single-payer).

PCP training and placement programs: Efforts to offer scholarships, subsidies, and guaranteed placement programs in order to increase the number of new practicing PCPs. *Players may offer these incentives for providers to the advantaged population, and/or for providers to the disadvantaged.*

Primary care efficiency: The fraction of PCPs whose practices or clinics are streamlined to run as efficiently as possible. This is sometimes referred to as idealized design of clinical office practices (IDCOP). The IDCOP approach comprises a number of techniques for appointment scheduling, staff utilization, and use of information technology. *Players may boost overall primary care efficiency.*

Quality of care delivered: The degree to which physicians enact best practices for preventive and chronic care, and hospitals enact best practices for urgent care. Reimbursement rates affect the incentive to adopt best practices and thereby affect quality. Quality can also be affected by programs to educate and support or facilitate adherence to best practice guidelines. *Players may improve: (1) preventive and chronic care, which includes screening to identify health concerns, as well as enhanced management of diseases, injuries, and asymptomatic disorders; and/or (2) urgent care, to treat events that require care in the emergency room or in an intensive care unit.*

Receipt of quality health care: The extent to which quality health care is received by the population. Different aspects of quality care confer different benefits: *Morbidity* declines through broader receipt of disease and injury management. *Mortality* drops for those suffering urgent events through broader receipt of quality urgent hospital care. (Quality urgent care also reduces the likelihood of hospital admission and of the subsequent need for nursing home or home health care.) And *onset of symptomatic disease* in the first place slows through broader receipt of asymptomatic disorder management. Also, the opportunity to receive disease management and asymptomatic disorder management is enhanced by broader receipt of appropriate routine screening.

Reimbursement rates: Amounts per visit paid by insurers to physicians or hospitals, expressed relative to their initial values (=1). The relative reimbursement rate for *office visits* affects payments for visits to primary care

physicians and specialists. The relative reimbursement rate for *hospital visits* affects payments for hospital inpatient stays as well as visits to emergency and outpatient departments. *Players may modify these reimbursement rates up or down.*

Self pay fraction for the insured: The fraction of health care costs, including self-paid premiums and out-of-pocket expenses such as co-pays and deductibles, that is paid by those who have insurance coverage, sometimes known as the "cost sharing fraction." *Players may raise or lower the self pay fraction.*

Socioeconomic disadvantage: Low socioeconomic status, defined operationally as the fraction of the population in households earning less than $25,000 per year. For simplicity, we differentiate only between the disadvantaged and the advantaged, and do not differentiate more groups along the social gradient. Most variables in the simulator have separate values for the advantaged vs. the disadvantaged population. The fraction of disadvantaged people may increase over time as people fall into disadvantage or decrease as they escape disadvantage. *Players may create pathways to advantage, for example, by assuring better education, job training, or living wage policies.*

Sufficiency of primary care providers (PCPs): The adequacy of primary care provider supply to meet potential demand for their services. The potential demand for visits increases with the size of the insured (and not self-paying) population and, in particular, the number of patients with acute problems or those being managed routinely for chronic problems. Higher quality of care puts a greater time burden on PCPs, but that burden could be reduced somewhat through improvements in operational efficiency.

Use of specialists & hospitals for non-urgent care: The amount of non-urgent care provided by specialists and hospitals rather than PCPs. A shortage of primary care providers leads more people to seek care by specialists and hospital outpatient clinics and emergency departments for non-urgent matters. Much of the demand for such care among the advantaged population can switch over to specialists, but this is not so for the disadvantaged population, who more often end up at hospital clinics for minor acute problems. Also, specialists can accept additional patients (as long as they have private insurance) for ongoing management of chronic disease and organic disorders, but hospitals lack this flexibility. For this reason, many disadvantaged people, even if they have Medicaid, will end up without appropriate routine care if there is a shortage of PCPs in their area.

What Information Sources Were Used?

Below is a list of the main data sources and influential references that were used to formulate the current game. A detailed Reference Guide is being developed to provide a narrative explanation of the game's structure and numerical assumptions.

Databases

- Behavioral Risk Factor Surveillance System
- National Ambulatory Medical Care Survey
- National Health Expenditure Accounts
- National Health Interview Survey
- National Health and Nutrition Examination Survey
- National Hospital Discharge Survey
- National Vital Statistics Reports
- U.S. Census

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